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Performing a linear model: The professor group on energy policy

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ABSTRACT

The linear model of science-policy interaction presents scientific knowledge as a necessary and straightforward requirement for rational decision-making. While the practices related to the linear model have been criticized by science policy actors and research funders, who promote more participatory arrangements, the linear model persists in both research policy and practice. This study investigates why and in which form the linear model continues to exist. I focus on the "professor group on energy policy", a voluntary and bottom-up science-policy initiative active in Finnish energy policy debates during 2013–2017. The analysis is based on interviews, reports, news articles and observations. I assess both the engagement practices of the group and how they are justified and evaluated. The study demonstrates the prevalence of the linear model as a repertoire that different actors employ to order science and policy. The results point to the need to critically assess the context, politics and expectations related to science-policy interaction.

1. Introduction

The social sciences have long debated how to structure relations between science, policy and society. A broad shift from emphasizing linear models and responses from single disciplines towards transdisciplinary approaches and the inclusion of novel actors has occurred (Callon et al., 2009; Felt et al., 2016; Chilvers and Kearnes, 2020). This shift has been motivated by attempts to find appropriate, credible and democratic responses to complex environmental and health concerns. National and international research funders, such as the European Commission, have established funding schemes to promote the inclusion of new actors in scientific processes. Likewise, researchers have suggested reorganizing the processes of knowledge production (e.g. Gibbons et al., 1994; Etzkowitz and Leydesdorff, 2000; Stilgoe et al., 2013), as well as increasing and improving communication between science and its publics (e.g. Michaels, 2009; Meyer, 2010). While the array of propositions is wide, a common feature has been the call to replace traditional closed and linear modes of scientific endeavour and societal interaction with more participatory means of knowledge production and communication (Lemos, 2018).

At the same time, research drawing on science and technology studies (STS) has demonstrated that the linear model, where science and society are viewed as mirror images of one another, persists (Turnhout and Gieryn, 2019). The linear model relegates the search for truth to the scientific realm while leaving questions of power and decision-making to politics. Recent research has demonstrated that the linear model endures both as an ongoing practice in science-policy interaction as well as an ideal by which science-society relations are prescribed (Beck, 2011; Turnhout et al., 2013; Felt et al., 2016). The mismatch between the wider trend towards participation and the observed persistence of the linear model forms the starting point of this article. If the linear model is highly criticized by current research and out of favour in research funding, why and in which form does it persist in science-policy interaction?

Answering this question calls for empirical research on the practices of science-policy interaction and their justifications. To analyse this question, I turn to an empirical case study on a group of professors who played an active and public role in energy policy debates in Finland during 2013–2017. While the self-named 'professor group on energy policy' has been identified as a new destabilizing actor in Finnish energy policy, it has not been previously analysed in depth(see Kivimaa and Kern, 2016; Haukkala, 2018; Hukkinen, 2020; Kainiemi et al., 2020). The ad hoc and informal group is an example of a bottom-up science--policy initiative where a group of professors sought to influence Finnish energy policy through public interventions and private meetings. I analyse both how professor group members and other energy policy actors assess the engagement practices of the professor group and how they use repertoires to justify those activities. As the group was self-organized, the way its engagement with policymaking and politics is justified sheds light on tacit ideas about the appropriate roles for academics in the public sphere. Moreover, other energy policy actors' assessments of the group highlight the understudied views of potential knowledge users and how they structure and evaluate science-policy interaction (Van Stigt et al., 2015; Kowalczewska and Behagel, 2019).

To provide a nuanced analysis of the linear model, the study presents a novel theoretical categorization. I argue that the linear model persists

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in three distinct ways: i) as a mirror image for participatory claims ii) as an activity at the science-policy interface and iii) as a repertoire used to justify engagement. While the activities of the professor group fluctuate between the linear model and more participatory modes of engagement, both professor group members and other energy policy actors use solely a linear repertoire to evaluate and justify the group's activities. This demonstrates how the linear model is demanded in science-policy interaction and the way both knowledge producers and potential knowledge users employ it as a repertoire to enact order in science-society interaction.

2. Persistence of the linear model

The linear model of science-society relations is based on the assumption that science and society are two distinct spheres of action, guided by different values and practices. Interaction between science and politics is described as *'unidimensional, linear and one-way: from science to policy ("truth speaks to power")'* (Beck, 2011, p. 298). This description sets firm boundaries between science and politics by locating 'truth' in the realm of science and leaving 'power' to the political arena (Ezrahi, 1990; Jasanoff and Wynne, 1998). A linear model relies on two strongly interlinked elements: i) temporal linearity – in which science first produces 'results' that are later fed into policy and ii) spatial linearity – or the proposition that science and politics should maintain a distance. Temporal linearity serves to purify the practices of science from political choices by advocating that politics should enter the equation only after the completion of scientific work. In turn, spatial linearity separates science and politics into distinct spheres with different practices and ethics, affording scientists the distance to uphold authority and credibility while retaining decision-making in the hands of politicians and policy-makers (Turnhout et al., 2014). The linear model's combination of temporal and spatial linearity produces the assumption that results from 'sound science' can be translated into rational decision-making and hence create better policies (Jasanoff and Wynne, 1998; Beck, 2011; Koetz et al., 2012).

The linear model has been criticized for being a simplistic representation of both scientific practices and policy-making. Turnhout and Gieryn (2019) summarize three central criticisms of the linear model. First, science serves as only one input to decision-making, which must consider and balance between different societal interests (Jasanoff, 2011). Second, scientific knowledge does not translate automatically into policy action; rather, it requires interpretation, evaluation and accommodation with other knowledge claims. Third, scientific knowledge is not produced separately from societal concerns, but is imbued with norms, values and power (Jasanoff, 2004). While the critique of the linear model is convincing, the model nonetheless continues to be evoked both in the science policy literature and in practice. Hence, Turnhout and Gieryn (2019) describe the linear model as a 'powerful ideal' to which many scientific and societal actors adhere. However, for a policy model to endure, it must go beyond being an ideal. Voß (2014) argues that to persist, policy models must demonstrate both epistemic and political promise and be relevant to both policy-makers and policy scholars. In the following, I present a novel categorization of three different ways in which the linear model persists, based on a theoretical review.

First, the linear model prevails as a mirror image for views on reshaping science-society relations. Thus, more participatory modes of science-policy interaction can be promoted by contrasting them with the linear model (see also Sundqvist et al., 2018). For example, research funders and science policy actors have consistently used a range of concepts originating from science and technology studies (STS) and science policy studies, such as Mode2 science (Gibbons et al., 1994), responsible research and innovation (RRI) (Stilgoe et al., 2013) and, most recently, co-production (Nature, 2018; Lemos, 2018), to demand reorganization of science-society relations away from linear assumptions and practices. Moreover, recent funding calls from the European Commission insist that knowledge production and knowledge use cannot be maintained as distinct and separate spheres; rather '*all societal actors[should]…work together during the whole research and innovation process*' (European Commission, 2019). Here the linear model persists because it serves as a way to describe undesirable science-society relations and present solutions that match this diagnosis (see also Sundqvist et al., 2018; Thoni and Livingston, 2019). Thus, rather than holding political promise to funders and policymakers as a desirable way to organize science-society relations, the linear model offers a reflection point to describe and promote alternative participatory practices.

Second, studies drawing on STS recognize the linear model as an ongoing practice in science-policy interaction. Practicing linearity refers to structuring engagements in such a way that there is spatial and temporal distance between science and policy. Empirical studies note how scientists maintain temporal and spatial linearity in their interactions with different publics by, for example, communicating only completed research results to publics, refraining from opening up research practices and using linear models of explanation (e.g. Davies, 2008; Beck, 2011; Heidenreich, 2017). In the knowledge brokerage literature, this has been referred to as a 'pure scientist' or 'servicing' position, where scientists seek to deliver objective and independent facts to decision-making processes without interfering in the process itself (Pielke, 2007; Turnhout, 2019). However, this practice is effective only when there is a clearly articulated knowledge question for researchers to study, and, even then, the role involves endorsing a pre-defined problem frame and the values attached to it (Turnhout, 2019). Paradoxically, studies find linear engagement to be prevalent in contexts where novel participatory practices, such as knowledge brokerage or transdisciplinary engagement, have been promoted by research funders or university infrastructures (Turnhout et al., 2013; Felt et al., 2016). This means that demands to create new roles for scientists have ultimately produced linear practices of engagement. In these cases, the linear model persists as an epistemic tool used by STS scholars to describe empirically observed practices in science-policy interaction.

Third, the linear model has been described as a repertoire that different actors draw upon to justify and describe scientists' activities in the public sphere and the ideal relations between science and society. A repertoire refers to a shared way of making sense of something, involving the use of similar expressions and style (Gilbert and Mulkay, 1984). Repertoires offer a 'vocabulary of justification' that scientists may use to describe and justify activities to different audiences (Mulkay, 1976; Gieryn, 1983). The linear model can be characterized as a repertoire, since it provides standardized verbal formulations to categorize and justify activities, yet allows for flexibility in accounts. Previous studies have demonstrated that a linear repertoire is employed to justify specific activities in science-policy interaction, such as refraining from taking part in participatory knowledge production (Turnhout et al., 2013). Moreover, a linear repertoire has also been used to describe ideals in science-policy interaction. For example, Saarela (2019) reports how researchers active in forest bioenergy policy in Finland expressed the desire to act as 'pure scientists' focused on objective data production. At the same time, however, these researchers could provide few examples of situations where they could practice linear interaction and refrain from adopting more involved roles. In these cases, the linear model persists as a political tool that offers a meaningful way for scientists and other societal actors to describe science-policy relations.

In summary, analyses of the linear model require nuance, as it takes several forms in the practice of and literature on science-policy interaction. While these forms are interrelated, it is analytically helpful to distinguish between instances where i) the linear model structures *activities and practices* in science-policy interaction and ii) the linear model is used as a *repertoire* to justify and provide meaning to activities in science-policy interaction. Both activities and the repertoires used to describe them are performative: they both represent and constitute science-policy interaction through activities and words (Callon, 2007, 2010; Turnhout et al., 2016Turnhout et al., 2016). By carrying out

specific engagements in science-policy and using repertoires to describe those activities, researchers and other societal actors perform a particular ordering of science and policy. These performances are shaped by the surrounding material contexts and social relationships (Behagel et al., 2019). Knowledge users participate in determining what roles experts can and cannot perform (Turnhout, 2019). Acting and justifying action in science-policy is thus not a neutral exercise; rather, it is a process that is shaped by and contributes to tacit assumptions about the role of science in society.

3. Materials and methods

The current article is based on observation of the work of the professor group on energy policy over a period of three years, from early 2015 to early 2018. The analysis centers on interviews with both professor group members and other energy policy actors, documents, media materials and participant observation (Table 1). The interviewees were selected to represent different types of organizations and expertise in Finnish energy policy. Due to the relatively small number of actors involved in Finnish energy policy and actors' awareness of one another, the interviewees are referred to by their relevant stakeholder groups, a practice which was discussed with and approved by the interviewees.

The interviews, which followed a semi-structured interview guide, were conducted by myself and another researcher. During the interviews, I focused on the role of the professor group and the use of science in decision-making. With members of the professor group, I discussed their motivation for joining the group, the strategies employed by the group, the role of scientific knowledge in the group's work and accounts of the group's successes and failures. With the other interviewees, I discussed the role of academics in energy policy, the use of scientific knowledge in their own work and views on the ideal relations between science and society.

My initial interest in the professor group was sparked by coordinating a funding proposal for the group during the entire month of May 2015.[1] My work was administrative, and I was not involved in any of the group's substantive activities. I began my PhD studies later the same year with the intention of using the professor group as one of my case studies. Two of the professors involved in the group were part of the same research project that funded the majority of my PhD,[2] and one of them acted as my PhD supervisor. In addition, I have had three other academic advisors who were uninvolved in the professor group. The research for this article was designed, conducted and analysed independently and no requirements on the substance of the research were imposed by the project or any of my thesis advisors. My supervisor involved in the professor group was neither interviewed for the research nor granted access to any of the interview material. I have received comments on the research from all my thesis advisors and numerous academics peers in seminars and conferences. Nevertheless, the choices on research design, analysis and presentation remain my own.

Table 1
Empirical material.

Material	Details
Interviews with energy policy actors (24)	- Environmental NGOs and citizen activists (4) - Industry groups (6) - Ministry representatives (3) - Politicians (3) - Professor group members (3) - Other academics (1) - Other [multiple affiliations] (4)
Professor group publications (3)	- New energy policy for providing growth and employment - *The principles of good energy policy–changing old ways of operating* - *Our Nation's Energy*
Media	- News articles - Youtube video 'What is wrong in Finland's energy policy?' - Investigative journalistic TV documentary MOT 'Wrong power policy' featuring the professor group
Events	- Panel discussion 'The moving boundaries of energy policy' at Science Days - Opera 'Our Nation's Energy'

The analysis focused on the ways in which the linearity of science, policy and politics was articulated in the interviews and collected materials (Table 1). I examined how different actors ordered science and policy through constructing boundaries and how they discussed the appropriate role for academics in public debates. To analyse the linear model as a repertoire, I focused on the use of expressions and terms regarding the relations between science and policy. This involved several interpretative readings of the empirical material, a task which was assisted by coding with Atlas.ti software and ordering the research material according to themes and interviewees in Excel. The analysis distinguishes between the activities of the group (Section 4) and the repertoires that different actors used to evaluate those activities (Section 5).

4. Situating the activities of the professor group in Finnish energy policy

The Finnish energy sector is characterized by high levels of energy consumption and a diverse and centralized fuel supply that relies on nuclear energy, biomass and fossil fuels. Industy is one of the largest energy users and has shaped energy policy through demands for affordable and secure energy from centralized production (Heiskanen et al., 2019). Consequently, distributed renewable energy has increased slowly, accelerating only in the latter half of the 2010s (Statistics Finland, 2020). Finnish energy policymaking has been described as corporatist, where a small, but powerful, group of actors consisting of ministries, energy industry and energy intensive industry, has been influential and ENGOs and academics have had limited influence on policy processes and outcomes (Ruostetsaari, 2009; Haukkala, 2018; Kainiemi et al., 2020). The motivation to participate in the professor group should be considered against this background, where energy policy is viewed as being controlled by a small group of actors who share similar ambitions (Ruostetsaari, 2010; Kainiemi et al., 2020).

The professor group was initiated in the summer of 2013 when one of the founding professors was approached by an old acquaintance (a freelance public relations consultant formerly active in university politics), who later became the group's coordinator. The coordinator was inspired by the global trend in renewable and decentralized energy and wished to raise energy policy as one of the key themes of the 2015 parliamentary elections. To do this, the professor and coordinator decided to bring together a group of ten academics with diverse expertise and name it 'the professor group'. Their aim was to influence energy policy through public interventions, as one of the professors described: '*There had not been such a group of researchers, who have undeniable expertise on energy policy, who would disagree with what the Ministry of Economic and Employment affairs or the government said. And that they would do this in public and try to have an influence*' (Professor group member, June 2016). The majority of my interviewees agreed that the professor group was unprecedented in Finnish energy policy because

[1] I was employed at another Finnish university at the time and had not begun my PhD studies.

[2] This was an Academy of Finland funded research project titled DEFEND (*Decentralizing Finland's energy regime: the triggers and dynamics of transition, 2014–2018*).

it openly challenged both the content of energy policy, especially the heavy reliance on centralized production, and the processes of negotiating policy, specifically their lack of openness and transparency.

During autumn 2013, the coordinator organized informal meetings where group members discussed desirable changes in Finnish energy policy. The group did not deliberate extensively on producing outputs or policy interventions. Rather, group members recall free-flowing conversations that led to the production of the group's first report: *'We just talked for a while. And X organized the morning coffees. And I wondered whatwasgoing to happen. And then the report emerged. I'm not really sure how it emerged.'* (Professor group member, June 2016). The motivation to influence policy was bottom-up and driven by the professors' frustration with current energy policy. Group members did not see remaining simply within 'academia' as an option, but considered participating in public debates part of being an engaged academic: *'In a way, if you're researching energy and energy policy and you never participate;it's a bit… so what? And if the work is just that you write these academic articles in international [journals], that's of course super important, but there's a 100 articles a day written and few read them, well, they are read but… But not participating at all, it's a really unfamiliar thought for me'* (Academic, June 2016).

The group made its first public appearance in February 2014 with the publication of a report titled *'New energy policy for providing growth and employment'* (Halme et al., 2014a). The report highlighted the need to use domestic resources to benefit from ongoing energy transitions and to reorient energy policy to serve *'the benefit of the nation'* (Halme et al., 2014a). The launch event, aimed at the media and politicians, included invited commentaries on the report from two high-profile politicians (a former and a future prime minister), organized through the extensive contacts of the coordinator. The report was strategically framed around growth and employment to enable conversations across the political spectrum. Group members did not view the report as a scientific output but rather as a pamphlet created to facilitate conversations with non-academic audiences: '*It was a fun paper in the sense it was not in all parts the academically strongest paper. Or it was kind of. But that points to it being written largely by the coordinator. But it was politically very useful. And sufficient*' (Professor group member, June 2016). The report was noted in the largest daily newspapers in Finland, thereby consolidating use of the term 'professor group' .[3]

Following the launch, group members began meeting with party leaders and political assistants from all major political parties (see Table 2). The aim of the meetings was to inform politicians of the group's key messages, namely the benefits of global energy trends towards renewables and decentralization, utilizing domestic resources and increasing openness and transparency in energy policy. To support these efforts, the coordinator initiated a phone lobbying campaign targeting the district offices of the four largest political parties and informing them of the group's report and its key message, with the expectation that this would filter up to the party leaders.

Following the 2015 parliamentary elections, the group was invited by the electoral winner, the Centre Party, to attend negotiations over the government programme, typically attended only by political party members and policymakers. One of the professors and the coordinator gave a brief presentation, based on the group's reports, to a working group on energy policy. The professor group's presence at the negotiations was not noted in the media, but it was well known amongst the energy policy actors I interviewed. While group members themselves reflected on the difficulty of knowing the impact of such engagements, other actors in energy policy described the invitation as a measure of the group's success in promoting itself as a new voice in Finnish energy policy.

Table 2
Professor Group's key activities.

Type of activity	Amount of activity[a]	Timeframe
Internal group meetings	10–20	2013–2017
Publications • *New energy policy for providing growth and employment* • *The principles of good energy policy–changing old ways of operating* • *Our Nation's Energy (book)*	3	2014–2015
Meetings with politicians, policy advisers, business	approx. 100	2013–2015
Media commentaries and appearances	approx. 20–40	2014–2017
Call campaign to local political party officials	approx. 700 calls	2014
Youtube video 'What is wrong in Finland's energy policy?'	watched approx. 5600 times	October 2014
Academy of Finland Strategic Research funding proposal	1	May 2015
Investigative journalistic TV documentary MOT 'Wrong power policy' featuring the professor group	watched approx. 22,000 times	September 2015
Panel discussion 'The moving boundaries of energy policy' at the Science Forum	1	January 2017
Opera 'Our Nation's Energy'	A few individual shows	May 2018, April 2019

[a] These are estimations based on group members' interviews and other research material (see Table 1).

During the election spring, the professor group attempted to formalize itself and receive funding to conduct collaborative research through a proposal submitted to the Academy of Finland Strategic Research Fund.[4] Until then, all the work carried out by the professors had been voluntary. The funding application was unsuccessful and the enthusiasm that had sustained the group during 2014–2015 began to wane: '*and that the group has faded afterwards just demonstrates that it was possible at a certain time, and the next window may come later. And the same model might not work then*' (Professor group member, June 2016). The group has not been publicly active since January 2017, when it made a brief reappearance at the Science Forum (see Table 2 for a chronological account of group activities).

The above account of the group's activities demonstrates how members actively sought to influence politics and policymaking through knowledge production aimed at reframing energy policy debates. The public and private interventions of the group influenced three different campaigns during the electoral spring of 2015. First, the group served as an 'external expert group' for the New Energy Policy (NEP) initiative, launched shortly after the professor group published its first report. The NEP was a lobbying project initiated by the coordinator of the professor group with aims derived from the professor group's reports (NEP, 2015). Second, the professor group was cited as an 'inspiration' for the citizen-led campaign 'Energy Renovation', which called for parliamentary candidates to publicly commit, in the spring 2015 elections, to pursuing a 100 % renewable energy future. Third, successful parliamentary candidates in the 2015 elections formed an informal Energy Renovation group in the Finnish Parliament to serve as a discussion forum for parliamentarians.[5]

[3] Media articles included headlines such as 'Professor group states: Swedish energy policy ahead of Finland' (*Helsingin Sanomat* 26.02.2014), 'Professor group: Promote domestic energy instead of imported energy' (*Maaseudun Tulevaisuus* 26.02.2014) and 'Professor group: Finland to be self-sufficient in energy by 2050' (*Iltasanomat* 26.02.2014).

[4] This new funding instrument was established in 2014 with the aim of creating 'high quality research that has great societal impact' (Academy of Finland, 2020). This was the research proposal that I coordinated throughout May 2015.

[5] See Haukkala, 2018 and Kainiemi et al., 2020 for more details on the Energy Renovation campaign and further discussion on civil society activity in Finland during and after the 2015 elections.

While the group's work was largely ad-hoc, all of the professors interviewed for the study emphasized the coordinator's role in assembling the group, managing its meetings and publications, creating ties to relevant stakeholders and ensuring that all the professors willingly devoted their time to the group. The coordinator of the group was actively involved in all of the above activities, especially the NEP lobbying project, for which he gathered funding from interested companies. The coordinator and the professors, nevertheless, discussed all the initiatives as separate projects, with the professor group as an independent expert group. The professor group did not produce any materials in collaboration with other actors, and engagement with the other initiatives was managed through the coordinator.

This section demonstrates how the activities of the professor group fluctuated between linear and collaborative modes of interaction. The professor group was neither a traditional research project that conducted primary research nor a collaborative research project focused on knowledge co-production with other stakeholders (c.f. Lövbrand, 2011; Bremer and Meisch, 2017). Instead, the claims made by the group were based on the members' acquired expertise in the field and were often responsive to current political events. In line with the linear model, the knowledge production of the group occurred in a small and closed circle, for example during the drafting of reports. The group's aim was to deliver this knowledge to policy-makers and politicians in a linear manner, such as in the phone lobbying campaign. At the same time, the professor group went beyond the linear model in its extensive communication activities and public interventions. The group sought to actively reframe Finnish energy policy, as evinced in its report titles and media appearances. It also aimed to create space for other actors to participate in energy policy: *'So we make this output and then try to feed the different sprouts… the idea is that you cannot decide what others will come up with'* (Other, June 2016). This shows the group's willingness to adopt new roles for academics, participate in publics debates and collaborate with a wide range of different actors.

5. Using linear repertoires to justify science-policy interaction

The professor group justified its activities through a linear repertoire that demarcated scientific processes from interest-driven political ones. The group's second report, published in October 2014 (see Table 2), highlights the need for unbiased expert advice in policy. The report sketches a linear progression from fact collection to applied use in scenario creation. Scenarios are presented to political groups, whose responsibility it is to make the value-driven choices on desirable energy policy. The description of desirable activities in science-policy interaction follows a linear model where science i) predates policy, ii) is spatially different from politics and iii) is assumed to improve decision-making (Halme et al., 2014b). The report identifies expert consensus as an important input for policy-making and situates value choices in the political realm. It raises a linear conception of interaction to the front-stage of science-policy interaction, whereas meetings with politicians, business representatives and activists are kept backstage and not discussed in depth in the reports (see also Hilgartner, 2000).

Using a linear repertoire, the professor group carved out a position for expert knowledge in Finnish energy policy and designated that position to the group. This is achieved by first identifying a degree of undesirable separation between science and policy in current energy policy, arguing that current decision-making fails to consider scientific knowledge sufficiently. The professor group then proceeded to present itself as the solution that would introduce more formalized scientific knowledge to policy-making and thus improve decision-making (see also Sundqvist et al., 2015). This is achieved by conceptualizing good policy as based on *'real-time and independent researched knowledge'* (Halme et al., 2014b) and good policy processes as requiring *'specific attention to openness, independence and relying on the best available knowledge'* (Halme et al., 2014b). In doing so, the professor group aimed to become the relevant source or 'obligatory passage point' for useful and policy-relevant knowledge on energy policy in Finland (Callon, 1984; Turnhout et al., 2014)

It is important to remember that the professor group had no outside mandate to conduct certain types of activities or to justify its interactions with various energy policy actors. As a bottom-up initiative, the group was not required by a funder to provide useful knowledge or to co-produce research with participants (c.f. Lövbrand, 2011; Lemos, 2018). The prominence of a linear repertoire thus exemplifies more tacit social norms regarding the appropriate activities for academics in the public sphere, which I discuss further in the next section.

Other energy policy actors also used a linear repertoire to evaluate the professor group. Several ENGOs and people working on the interface between research and communication welcomed the contributions of the professor group and used them as the basis for further campaigns (see Haukkala, 2018 and Kainiemi et al., 2020). They portrayed the group as an autonomous entity that brought academic credibility to the campaigns and was useful in opening a space for other actors to participate in energy policy with new framings. The interviewees demarcated their own activist work from the professor group. In their view, the professor group possessed relevant facts and could be consulted when deemed necessary. The group was not seen as an active partner in citizen initiatives; rather, it was perceived as a '*shady group of wise old ones that is there somewhere, who think we're doing the right things without any one of us ever having met these professors. But we knew that if we needed, we could always get them to talk on our behalf, and if we ran out of arguments, to argue for us'* (ENGO/Activist, November 2016). The professor group was described as a neutral entity in the politically loaded environment of energy policy, assisted by '*having science behind them*' (Industry group, February 2017) rather than being driven by values. In emphasizing the distance between the professor group and other societal actors, the supporters of the professor group thus enacted the linear model.

Those critical of the professor group likewise used a linear repertoire. These interviewees claimed that the professor group had failed to function in a linear manner and maintain the appropriate distance between science and policy. In a news article, the director of the main energy industry lobby stated, '*already then, it made us at Finnish Energy wonder at the way professors had entered politics*' (Tamminen, 2017). The director criticized the group for misusing their academic position to lobby for renewable energy (Tamminen, 2017). In this case, the group was not presented as a neutral expert body, but rather as a closed circle of likeminded academics who aimed to distort energy policy. The criticism from the energy industry is unsurprising, as the professor group's reports negatively frame the energy industry as exemplary of 'old energy policy'. Criticism of the group for 'stepping into politics' reasserts the view that academics should adhere to the Mertonian CUDOS norm of disinterestedness (Merton, 1973) and maintain the separation between science and policy. This criticism elucidates how efforts to uncover the backstage of science-policy interaction tend to highlight informal arrangements, such as the professor group's collaborative activities with politicians, as acts of impure science (Hilgartner, 2000). This, in turn, enacts the linear model as the correct way to structure science-policy relations.

Criticism of the professor group drew upon a linear repertoire to discuss what academics should be entitled to do and when. Some energy policy actors disapproved of academics adopting unconventional roles: '*They wanted to come and inspire political decision-makers. So they did not want to produce any knowledge. We do not need anything like that… I wish they would do research and real work'* (Ministry representative, March 2017). These interviewees emphasized that, to be useful, the professor group should deliver research results as inputs to policy-making processes, rather than make topical comments on energy policy. They expected academics to provide lists of decision options and estimations on their consequences (see also Dewulf, 2020). All of these actors underlined the importance of academics participating in debates. However, according to them, that participation should be limited to presenting

research results, thus adhering to a 'pure scientist' or 'servicing' model of science-policy interaction (Pielke, 2007; Turnhout, 2019). As the professor group sought to reframe energy policy debates, it stepped beyond the 'servicing' model to which some actors wished it to be consigned: '*The discussion [of the professor group] was not one that was looking for the truth or the best possible way to proceed, but rather one of forwarding a specific view far too strongly*' (ENGO/Activist, April 2017). At the same time, some of the same actors were able to reflect on the contradictory expectations this placed on academics: *'Like I was just complaining that some professors cut corners too much and use too much rhetoric. But it's not easy… In general, there should be more popular debate, because the knowledge they produce is not useful if it does not end up with people who can use it in their decision-making and their lives'* (ENGO/Activist, April 2017). This demonstrates an ambiguous desire among some interviewees for more participatory activities at the science-policy interface. Simultaneously, however, these same interviewees promoted a linear repertoire.

6. Discussion and Conclusion

This research has examined why and in which form the linear model persists in science-policy interaction through a case study on a group of professors who made a series of public and private interventions in Finnish energy policy. Based on a theoretical review, I have argued that the linear model persists as i) a 'mirror image' against which claims for more participatory research can be reflected upon, ii) a practice that structures science-policy interaction and iii) a repertoire to provide meaning to science-policy interaction. The empirical case study shows the prominence of the third explanation, whereas the former two are less relevant in this context.

In the case study, the linear model is a demanded reality of science-policy interaction rather than a 'mirror image' for more participatory claims. While both the literature on participatory knowledge production and the practices of research funders argue against the political promise of the linear model, my empirical results show the opposite. That is, both academics and other societal actors demand linear science-policy interaction in specific contexts. This is because the linear model provides much-desired meaning and clarity over the allocation of roles and responsibilities in science-policy interaction. Even if this is rarely a realistic description of complex science-policy relations, it is a desired and politically powerful ordering of science-society relations.

In most cases, the linear model is an insufficient way to describe practices and activities at the science-policy interface, since these activities can rarely be confined to linear engagement. As Turnhout et al., 2016 state, '*being policy relevant is to be policy prescriptive*'. This means that cases where academics can act from a 'servicing' or 'pure scientist' position (Pielke, 2007; Turnhout, 2019) are rare, and thus the majority of science-policy interaction cannot be confined to the linear model. In the case study, this is visible in the practical engagements of the professor group, which sought to actively reframe energy policy, interact with various policy stakeholders and respond to current policy questions. While the professor group produced its reports in a closed circle, from the beginning the reports were structured to have a policy impact and engage a wide audience. The professor group did not adhere to a linear model where research aims are derived from the scientific literature and results delivered unilaterally to policy (see also Beck, 2011).

In the case study, the persistence of the linear model is best explained as a repertoire that provides meaning to science-policy interaction. Analysed as a repertoire that both knowledge producers (i.e. professor group members) and potential knowledge users (i.e. energy policy stakeholders) employ, the linear model offers political promise as a powerful way to constitute the science-policy interface. A linear repertoire is attractive to both academics and policy stakeholders, as it draws on decades of conceptualizing science and society as two distinct spheres of action (Merton, 1973; Jasanoff and Wynne, 1998; Sundqvist et al., 2018; Turnhout and Gieryn, 2019). The linear model evokes tacit norms about the appropriate role for academics in the public sphere and provides a 'vocabulary of justification' (Mulkay, 1976) to evaluate these.

The analysis demonstrates that current calls for increasing participatory knowledge production have not removed the appeal of a linear repertoire. In the case study, this is visible in the fact that while different actors offered vastly differing assessments of the professor group's interventions and their desirability, they nonetheless sought to support their claims for or against the group through a linear repertoire. As the political appeal of the linear model is so strong, I argue that research on science-policy interaction needs fewer heuristics and to-do lists to guide interaction and more empirically-oriented research on the context, politics and outcomes of interaction, especially in informal and politically-loaded settings (see also Felt et al., 2016; Gustafsson, 2019; Thoni and Livingston, 2019). The case study demonstrates the importance of scrutinizing the motivation and desires of different actors when they ambiguously call for academics to be both more involved in policy-making and adhere to a linear model of interaction.

In the case study, ENGOs, activists and supporters of renewable energy considered that the professor group had opened up entrenched policy debates and produced new framings for policy that could be further elaborated on and employed in campaigns (see also Kainiemi et al., 2020). They focused on the symbolic use of knowledge (see Beyer, 1997), where claims made by the professor group were used to legitimize their own criticisms of current policy and processes. Constructing credibility for the claims involved presenting the professor group as neutral and separate from political initiatives (e.g. the Energy Renovation campaign). Kowalczewska and Behagel (2019) have similarly shown how policy-makers in Poland demand linear interaction from academics in cases where a political backlash is feared. This places academics as 'speaking truth to power' in policy areas where it is difficult for other actors to do so due to, for example, power asymmetries and entrenched interests. In the case study, the professor group's interventions were valued for paving the way for more open policy debates, yet the stakeholders insisted that this had occurred without academics compromising their autonomy. This goes against the grain of current participatory research, where participatory knowledge production is presented as the key means to opening up policy debates, while linearity is assumed to close down debates (e.g. Koetz et al., 2012). It demonstrates the political promise of the linear model and how emphasizing the distance between science and policy is central to constructing credibility (Wynne, 2010; Jasanoff, 2011), and is further used by other energy policy actors to forward their own aims.

Conversely, those interviewees who were critical of the professor group saw the group as exceeding the boundaries of academic involvement in policymaking. They focused on the instrumental use of knowledge (Beyer, 1997), where adhering to a linear model of interaction should result in the production of direct inputs for policy. In their view, the professor group had not engaged in a linear fashion, and the interventions they produced were not considered relevant for current policy processes. These critics would have preferred scenarios or calculations to feed into pre-defined policy agendas, adhering to a 'servicing' model where current policy assumptions are taken for granted (Turnhout, 2019). These demands place academics in an ambiguous position. On the one hand, the expectation is for scientists to first 'get it right' before delivering solutions for policy (Beck, 2011). On the other hand, academics are expected to be aware of the needs and knowledge requirements of policy-makers and to be willing to participate in societal debates. This leads to conflicting claims for 'usable knowledge' combined with a reluctance to allow academics to adopt the 'new roles' that this requires (see also Dewulf, 2020).

The prevalence of a linear repertoire raises some questions that cannot be fully answered on the basis of the present study and thus require further discussion and research. Such questions as the extent to which actors intentionally employ a linear repertoire, are aware of the context they are engaging in, can reflect upon their own role and are able to influence their public image, are particularly difficult to evaluate

(see also Sundqvist et al., 2015 and Wynne, 2010). In his assessment of the professor group, Hukkinen (2020 p. 6) – a group member himself – states that the group was aware of the policy context and *'knew that their reports, seminars, and media interventions were not going to shift the momentum of Finnish energy policy'*. Being aware of the policy context, however, is different from being aware of the repertoires used to justify attempts to influence that policy context. My research shows that the group often resorted to a linear repertoire and therefore failed to provide the *'stage for self-reflexive dialogue and deliberation'* that Hukkinen (2020 p. 7) calls for science-policy interaction to move towards. At the same time, I do not claim that group members sought to intentionally obfuscate the engagements they had with politicians and use the linear model as a smokescreen. Rather, group members seem to have separated their engagements with politicians and decision-makers from the linear repertoire by which they gave meaning to those activities.

While academics and other energy policy actors favour a linear repertoire to publicly justify science-policy interaction, they also voice demands that are in conflict with the linear model, such as demands to increase academic involvement in public discussions and produce usable knowledge. However, these nuanced perspectives do not translate into a repertoire on desirable science-society interaction. This echoes Smallman's (2019) finding that nuanced public perspectives on risks, uncertainty and technological development cannot be accommodated within a governance machinery that favours an elite 'science to the rescue' imaginary. In the same way, a linear repertoire wipes away nuanced, plural and contingent perspectives on science-policy interaction and enacts a limited view on the role of science in society.

The persistence of a linear repertoire is therefore both pragmatic and normative. For professor group members, it is pragmatic in the sense that group members expected to create policy relevance and impact through involved and collaborative activities but nonetheless required a linear repertoire to justify those activities. For other energy policy stakeholders, employing a linear repertoire allows for a seemingly clear-cut separation between science and politics, which can be moulded to suit the political needs of different actors (see also Kowalczewska and Behagel, 2019). Using a linear repertoire shows a pragmatic awareness of the surrounding political context and a tacit adaptation to that context. This makes the use of a linear repertoire highly normative, though, as it contributes to solidifying a view of science and policy as fundamentally different. The use of a linear repertoire constitutes maintaining science and policy separate as the correct way of conducting interaction, idealizes particularly the role of the 'pure scientist' and results in entrenching an '*over-positivistic conception of what "real science" is*' (Sundqvist et al., 2015, p. 434).

This research has shown that the linear model persists particularly as a repertoire used to justify and evaluate science-policy interaction. In other cases, the linear model may endure more as a practice or a mirror image for more participatory claims. In general, it is likely that the linear model will co-exist alongside claims for more participatory research practices. Future research should therefore be aware of the different ways the linear model persists in science-policy interaction and seek to critically interrogate different actors' views on the desirable futures that are asserted via a linear repertoire. Pertinent questions include why different actors demand science-policy interaction in the first place, what is expected from interaction, and what good outcomes of science-policy interaction mean for different stakeholders. Addressing these questions can open up nuanced and plural views on science-society interaction that might be overlooked by a linear repertoire.

Author statement

This article is the sole work of Kamilla Karhunmaa.

Declaration of Competing Interest

The authors report no declarations of interest.

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